Science Standards of Learning

Sample Scope & Sequence

Life Science

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Virginia Department of Education
P.O. Box 2120
Richmond, Virginia 23218-2120
http://www.doe.virginia.gov

Superintendent of Public Instruction
Jo Lynne DeMary

Deputy Superintendent for Instruction
Patricia I. Wright

Assistant Superintendent for Instruction
Linda M. Wallinger

Office of Elementary Instructional Services
Linda Poorbaugh, Director
Paula J. Klonowski, Science Specialist

Office of Middle and High School Instructional Services
James C. Firebaugh, Director
Eric M. Rhoades, Science Specialist

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Preface

As an additional resource to help school divisions develop curricula aligned to the 2003 Standards of Learning, the Virginia Department of Education has developed sample scope and sequence documents for kindergarten through grade eight and for core high school courses. These sample documents provide guidance on how the essential knowledge, skills, and processes that are identified in the Standards of Learning and the Standards of Learning Curriculum Frameworks may be introduced to students in a logical, sequential, and meaningful manner.

These sample scope and sequence documents are intended to serve as general guides to help teachers and curriculum developers align their curricula and instruction to support the Standards of Learning. Each sample document is organized around specific topics to help teachers present information in an organized, articulated manner. Also included are correlations to the Standards of Learning for that curricular area for a particular grade level or course, as well as ideas for classroom assessments and teaching resources.

The sample scope and sequence documents are not intended to prescribe how curriculum should be developed or how instruction should be delivered. Instead, they provide examples showing how teachers and school divisions might present to students in a logical and effective manner information that has been aligned with the Standards of Learning. School divisions that need assistance in developing curricula aligned with the Standards of Learning are encouraged to consider the sample scope and sequence guides. Teachers who use the documents should correlate the content identified in the guides with available instructional resources and develop lesson plans to support instruction.

The *Science Standards of Learning Sample Scope and Sequence* and the *Science Standards of Learning Curriculum Framework* can be found in both PDF and Microsoft Word file formats on the Virginia Department of Education's Web site at http://www.doe.virginia.gov/VDOE/Instruction/sol.html.

Introduction

The following sample scope and sequence is based on the essential content, skills, and processes developed for each Life Science standard in the *Science Standards of Learning Curriculum Framework*. It is not intended to be a complete or exhaustive set of all that students should master at this level, but instead the scope and sequence organizes a core of key skills, content, and processes around basic topic areas.

The topic areas generally correspond to individual standards; however, certain standards are reorganized and grouped with components of other standards to comprise meaningful instructional clusters. The various topics are not intended to require equal instructional time. Additional objectives have not been developed, and no attempt has been made to transition or further explain the content. In some cases information from the Curriculum Framework overview has been reconstructed and included with the essential content skills and processes. Additional information may be obtained from the overview and introductory sections of the *Life Science Standards of Learning Curriculum Framework* (http://www.doe.virginia.gov/VDOE/Instruction/Science/sciCF.html).

An important and consistent thread among these organizational topics is the application of inquiry skills throughout. Students should have an opportunity to master the various science concepts in each topic area in the context of active learning and inquiry processes. The focus on inquiry is further reinforced by having the first topic in the scope and sequence as a discrete treatment of the science skills; however, a discrete treatment is certainly not required. This represents only one way to organize instruction; there are many other valid and useful organizational schemes.

Effective science teaching requires assessing and understanding what students know and need to learn and then challenging and supporting them to learn it well. The array of effective assessment techniques that teachers can employ in the classroom goes well beyond traditional assessments, and science instruction lends itself well to alternative approaches such as portfolios, student self assessments, and short videotaped presentations. The assessments mentioned in the scope and sequence are intended to be general. It is the role of the local curriculum to develop a detailed review of what is most effective for the particular concept being developed.

The resources section included in this scope and sequence provides a brief sample of instructional resources and staff development materials that are generally available without charge. There is a significant body of commercially available instructional materials that correlates well with the Science Standards of Learning and is of very high quality. This document, however, does not include references to those materials.

Organizing Topic	Related Standards
Investigation Skills and the Nature of Science	**LS.1**
Investigating Cell Theory	**LS.2, LS.1**
Investigating Patterns of Cellular Organization	**LS.3, LS.1**
Investigating Heredity and Genetics	**LS.13, LS.1**
Investigating the Classification of Organisms	**LS.5, LS.1**
Investigating Plants	**LS.4a, c, LS.11, a, LS.1**
Investigating Photosynthesis	**LS.6, LS.1**
Investigating Animals	**LS.4b, LS.5, LS.1**
Investigating Energy Flow	**LS.7, LS.1**
Investigating Populations	**LS.8, LS.11b, c, LS.1**
Investigating Communities	**LS.9, LS.1**
Investigating Adaptation and Change	**LS.11, LS.11c, LS.10, LS.1**
Investigating Biologic Evolution	**LS.14, LS.1**
Investigating the Conservation of Living Resources	**LS.12, LS.1**

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigation Skills and the Nature of Science (A discrete introduction to specific science skills is not necessary, as all of the inquiry skills should be incorporated within the following topical areas. Teachers may consider introducing some of these skills in isolation or coordinated with mathematics, English, and history instruction.)	**Students should be able to:** design a data table that includes space to organize all components of an investigation in a meaningful way, including levels of the independent variable, measured responses of the dependent variable, number of trials, and mathematical means. identify what is deliberately changed in the experiment and what is to be measured as the dependent (responding) variable. select appropriate tools for collecting qualitative and quantitative data and record measurements (volume, mass, and distance) in metric units. create physical and mental models as ways to visualize explanations of ideas and phenomena. evaluate the design of an experiment and the events that occur during an investigation to determine which factors may affect the results of the experiment. This requires students to examine the experimental procedure and decide where or if they have made mistakes.	LS.1	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Teaching and Learning the Basic Science Skills* videotape teacher training series and site guide: http://www.doe.virginia.gov/VDOE/Instruction/sol.html *Our Living Environment* teacher training module: http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigation Skills and the Nature of Science (continued)	analyze the variables in an experiment and decide which ones must be held constant (not allowed to change) in order for the investigation to represent a fair test. This requires students to comprehend what "variables" are and to apply that idea in new situations related to the Life Science SOL concepts. determine the specific component of an experiment to be changed as an independent variable and control the experiment by conducting trials for the experiment in which the independent variable is *not* applied. This requires the student to set up a standard to which the experimental results can be compared. The student must use the results of the controlled trials to determine whether the hypothesized results were indeed due to the independent variable.	LS.1		*Project WILD* activity guide: http://www.dgif.state.va.us/education/wildlife_ed.html *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project Learning Tree:* http://www.plt.org *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigation Skills and the Nature of Science (continued)	construct appropriate graphs, using data sets from experiments. This requires the student to recognize that a line graph is most appropriate for reporting continuous or real-time data. This also requires a student to comprehend that points along the line that are not actual data points can be used to make predictions. Students should be able to interpret and analyze these graphs. develop conclusions based on a data set and verify whether the data set truly supports the conclusion. This requires students to cite references to the data that specifically support their conclusions. distinguish between observational and experimental investigations. identify, describe, and apply the generalized steps of experimental (scientific) methodology.	LS.1		*VA Natural Resources Education Guide:* http://www.vanaturally.com/eduguide.htm SOL assessment blueprints and sample items *Science SOL Curriculum Framework:* http://www.doe.virginia.gov/VDOE/Instruction/Science/sciCF.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Cell Theory	**Students should be able to:** describe and sequence the major points in the development of the cell theory. identify the three components of the cell theory. distinguish among the following: cell membrane, cytoplasm, nucleus, cell wall, vacuole, mitochondrion, endoplasmic reticulum, and chloroplast. correlate the structures of cell organelles with their jobs and analyze how organelles perform particular jobs. compare and contrast examples of plant and animal cells, using the light microscope and images obtained from microscopes. differentiate between mitosis and meiosis. design an investigation from a testable question related to animal and plant cells. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. An example of such a question is: "Do onion cells vary in shape or structure depending on where they are found in the plant?"	LS.2	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	Cells Alive Web site: http://www.cellsalive.com/

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Cell Theory (continued)	analyze and critique the experimental design of basic investigations related to animal and plant cells. This analysis and critique should focus on the skills developed in LS.1. Major emphases should include the following: the clarity of predictions and hypotheses, the organization of data tables, the use of metric measures, adequacy of trials and samples, the identification and use of variables, the identification of constants, the use of controls, displays of graphical data, and the support for conclusions.	LS.2		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Patterns of Cellular Organization	**Students should be able to:** differentiate between unicellular organisms and multicellular organisms and name common examples of each. compare and contrast how unicellular and multicellular organisms perform various life functions. This includes the application of knowledge about systems in organisms. compare and contrast the various basic life functions of an organism, including respiration, waste removal, growth, irritability, and reproduction, and explain the role that each life function serves for an organism. model how materials move into and out of cells in the processes of osmosis, diffusion, and active transport. This includes creating and interpreting three-dimensional models and/or illustrations demonstrating the processes involved. Students should be able to analyze the components of these models and diagrams and communicate their observations and conclusions. differentiate among cells, tissue, organs, and organ~~s~~ systems.	LS.3	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Patterns of Cellular Organization (continued)	analyze and critique the experimental design of basic investigations related to understanding cellular organization, with emphasis on observations of cells and tissue. This analysis and critique should focus on the skills developed in LS.1. Major emphases should include the following: the clarity of predictions and hypotheses, the organization of data tables, the use of metric measures, adequacy of trials and samples, the identification and use of variables, the identification of constants, the use of controls, displays of graphical data, and the support for conclusions.	LS.3		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Heredity and Genetics (Note: This organizing topic also fits well in a sequence where it precedes the final topic presented in this scope and sequence sample.)	**Students should be able to:** recognize the appearance of DNA as double helix in shape. explain that DNA contains coded instructions that store and pass on genetic information from one generation to the next. demonstrate variation within a single genetic trait. explain the necessity of DNA replication for the continuity of life. differentiate between characteristics that can be inherited and those that cannot be inherited. distinguish between dominant and recessive traits. distinguish between genotype and phenotype. use Punnett squares to predict the possible combinations of inherited factors resulting from single trait crosses. identify aspects of genetic engineering and supply examples of applications. Evaluate the examples for possible controversial aspects.	LS.13	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	Mendel Web – genetics Web site: www.mendelweb.org

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Heredity and Genetics (continued)	describe the contributions of Mendel, Franklin, and Watson and Crick to our basic understanding of genetics.	LS.13		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating the Classification of Organisms	**Students should be able to:**		Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	
	compare and contrast key features and activities between organisms. classify organisms based on physical features. arrange organisms in a hierarchy according to similarities and differences in features. categorize examples of organisms as representatives of the kingdoms and recognize that the number of kingdoms is subject to change. recognize scientific names as part of a binomial nomenclature. recognize examples of major animal phyla. recognize examples of major plant phyla (divisions).	LS.5		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Plants	**Students should be able to:**		Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	Mathematics & Science Center on-line lesson, *Leaves: Adaptations for Food Making:* http://mathsciencecenter.info/mathinscience.html
	identify the basic needs of all living things. explain that there is a specific range or continuum of conditions that will meet the needs of plants. explain how plants obtain the materials and energy that they need.	LS.4a		
	understand that plants may respond to light by growing toward it or away from it (a behavior known as phototropism).	LS.11a		
	relate the responses of organisms to daily, seasonal, or long-term events.	LS.11		

	create plausible hypotheses about the effects that changes in available materials might have on particular life processes in plants. design an investigation from a testable question related to plant life needs. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	LS.4a,c		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Plants (continued)	analyze and critique the experimental design of basic investigations related to animal and plant needs. This analysis and critique should focus on the skills developed in LS.1. Major emphases should include the following: the clarity of predictions and hypotheses, the organization of data tables, the use of metric measures, adequacy of trials and samples, the identification and use of variables, the identification of constants, the use of controls, displays of graphical data, and the support for conclusions.	LS.4 a,c		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Photosynthesis	**Students should be able to:** describe the process of photosynthesis in terms of raw materials and products generated. identify and describe the organelles involved in the process of photosynthesis. describe that chlorophyll is a chemical in chloroplasts that can absorb or trap light energy. explain how organisms utilize the energy stored from the products of photosynthesis. relate the importance of photosynthesis to the role of producers as the foundation of food webs. design an investigation from a testable question related to photosynthesis. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	LS.6	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Photosynthesis (continued)	analyze and critique the experimental design of basic investigations related to photosynthesis. This analysis and critique should focus on the skills developed in LS.1. Major emphases should include the following: the clarity of predictions and hypotheses, the organization of data tables, the use of metric measures, adequacy of trials and samples, the identification and use of variables, the identification of constants, the use of controls, displays of graphical data, and the support for conclusions.	LS.6		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Animals	**Students should be able to:**		Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	
	distinguish between the needs of plants and animals. identify the basic needs of all living things. explain that there is a specific range or continuum of conditions that will meet the needs of animals. explain how animals obtain the materials that they need.	LS.4b		
	relate the responses of animals to daily, seasonal, or long-term events.	LS.11		
	explain that animals may respond to cold conditions with a period of lowered metabolism (a behavior know as hibernation).	LS.11a		
	create plausible hypotheses about the effect that changes in available materials might have on particular life processes in animals. design an investigation from a testable question related to animal life needs. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	LS.4b		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Animals (continued)	analyze and critique the experimental design of basic investigations related to animal needs. This analysis and critique should focus on the skills developed in LS.1. Major emphasis includes the following: the clarity of predictions and hypotheses, the organization of data tables, use of metric measures, adequacy of trials and samples, the identification and use of variables, identification of constants, use of controls, displays of graphical data, and the support for conclusions.	LS.4b		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Energy Flow	**Students should be able to:** observe and identify common organisms in ecosystems and collect, record, and chart data concerning the interactions of these organisms (from observations and print and electronic resources). classify organisms found in local ecosystems as producers or first-, second-, or third-order consumers. Design and construct models of food webs with these organisms. observe local ecosystems and identify, measure, and classify the living and nonliving components. differentiate among key processes in the water, carbon, and nitrogen cycles and analyze how organisms, from bacteria and fungi to third-order consumers, function in these cycles. determine the relationship between a population's position in a food web and its size. identify examples of interdependence in terrestrial, freshwater, and marine ecosystems. apply the concepts of food chains, food webs, and energy pyramids to analyze how energy and matter flow through an ecosystem.	LS.7	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Our Living Environment* teacher training module: http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc Chesapeake Bay Foundation Web site: http://www.cbf.org Chesapeake Bay Program Web site: http://www.chesapeakebay.net/ *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Energy Flow (continued)	design an investigation from a testable question related to food webs. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. analyze and critique the experimental design of basic investigations related to food webs.	LS.7		*Virginia Naturally: VA's Natural Resources Education Guide:* http://www.vanaturally.com/guide.html *Project WILD activity guide:* http://www.dgif.state.va.us/education/wildlife_education.html
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Populations	**Students should be able to:** differentiate between the needs of the individual and the needs of a population. explain that individual members of a population interact with each other. These interactions include competing with each other for basic resources, mates, and territory, and cooperating with each other to meet basic needs. interpret, analyze, and evaluate data from systematic studies and experiments concerning the interactions among members of a population. determine the relationship between a population's position in a food web and the types of interactions seen among the individuals of the population. explain that the establishment of a social order in a population may ensure that labor and resources are adequately shared. explain that the establishment of a territory ensures that members of a population have adequate habitat to provide for basic resources.	LS.8	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Our Living Environment* teacher training module: http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc Chesapeake Bay Foundation Web site: http://www.cbf.org Chesapeake Bay Program Web site: http://www.chesapeakebay.net/ *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Populations (continued)	observe and identify populations in ecosystems and collect, record, chart, and interpret data concerning the interactions of these organisms (from observations and print and electronic resources).	LS.8		*Virginia Naturally: VA's Natural Resources Education Guide:* http://www.vanaturally.com/guide.html *Project WILD activity guide:* http://www.dgif.state.va.us/education/wildlife_education.html
	compare and contrast the factors that increase or decrease population size.	LS.11b		
	predict the effect of climate change on ecosystems, communities, populations, and organisms. predict the effect of climate change on ecosystems, communities, populations, and organisms. classify the various types of changes that occur over time in ecosystems, communities, populations, and organisms.	LS.11c		
	analyze and critique the experimental design of basic investigations related to interactions within a population. This analysis and critique should focus on the skills developed in LS.1. Major emphasis includes the following: the clarity of predictions and hypotheses, the organization of data tables, use of metric measures, adequacy of trials and samples, the identification and use of variables, identification of constants, use of controls, displays of graphical data, and the support for conclusions.	LS.8		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Populations (continued)	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Communities	**Students should be able to:** identify the populations of producers, consumers, and decomposers and describe the roles they play in their communities. comprehend that in a community, populations interact with other populations by exhibiting a variety of behaviors that aid in the survival of the population. comprehend that organisms or populations that rely on each other for basic needs form interdependent communities. interpret, analyze, and evaluate data from systematic studies and experiments concerning the interactions of populations in an ecosystem. predict the effect of population changes on the food web of a community. comprehend that energy resources of a community are shared through the interactions of producers, consumers, and decomposers. comprehend that the interaction between a consumer that hunts another consumer for food is a predator-prey relationship.	LS.9	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Our Living Environment* teacher training module: http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc Chesapeake Bay Foundation Web site: http://www.cbf.org Chesapeake Bay Program Web site: http://www.chesapeakebay.net/ *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Communities (continued)	generate predictions based on graphically represented data of predator-prey populations. comprehend that populations of one species may compete with populations of other species for resources. Populations of one species may also cooperate with populations of other species for resources. generate predictions based on graphically represented data of competition and cooperation between populations. comprehend that symbiotic relationships include mutualism (in which both organisms benefit), commensalism (in which one organism benefits and the other is unaffected), and parasitism (in which one organism benefits and the other is harmed). differentiate between the types of symbiosis and explain examples of each. comprehend that each organism fills a specific role or niche in its community. infer the niche of organisms from their physical characteristics.	LS.9		*Virginia Naturally: VA's Natural Resources Education Guide:* http://www.vanaturally.com/guide.html *Project WILD activity guide:* http://www.dgif.state.va.us/education/wildlife_education.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Communities (continued)	predict the effect of large scale changes on ecosystems, communities, populations, and organisms (fire, drought, flood, etc.) on populations. predict the effect of climate change on communities. design an investigation from a testable question related to interactions among populations. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.	LS.11		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Adaptation and Change	**Students should be able to:**		Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Our Living Environment* teacher training module: http://www.doe.virginia.gov/VDOE/Instruction/OurLivingEnvironment.doc Chesapeake Bay Foundation Web site: http://www.cbf.org Chesapeake Bay Program Web site: http://www.chesapeakebay.net/ *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html
	differentiate between ecosystems, communities, populations, and organisms.	LS.11		
	differentiate between ecosystems and biomes.	LS.10a		
	comprehend that each of the Earth's major biomes is associated with certain conditions, including a range of climate and ecological communities adapted to those conditions. compare and contrast the biotic and abiotic characteristics of land, marine, and freshwater ecosystems. recognize and give examples of major biomes: desert, forest, grassland, and tundra.	LS.10b		
	comprehend that organisms have specific structures, functions, and behaviors that enable them to survive the conditions of the particular biome in which they live. observe and describe examples of specific adaptations that organisms have which enable them to survive in a particular ecosystem. comprehend that organisms adapt to both biotic and abiotic factors in their biome.	LS.10c		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Adaptation and Change (continued)	analyze specific adaptations of organisms to determine how they help the species survive in its ecosystem. (see LS.5 - external and internal structures, method of locomotion, obtaining nourishment of species, etc.)	LS.10c		*Virginia Naturally: VA's Natural Resources Education Guide:* http://www.vanaturally.com/guide.html *Project WILD activity guide:* http://www.dgif.state.va.us/education/wildlife_education.html
	predict the effect of large scale changes on ecosystems, communities, populations, and organisms. predict the effect of climate change on ecosystems, communities, populations, and organisms.	LS.11c		
	design an investigation from a testable question related to how organisms adapt to biotic and abiotic factors in an ecosystems. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. analyze and critique the experimental design of basic investigations related to how organisms adapt to biotic and abiotic factors in ecosystems.	LS.10c		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Organic Evolution	**Students should be able to:** explain how genetic variations in offspring, which lead to variations in successive generations, can result from the same two parents. comprehend that adaptations are structures, functions, or behaviors that enable a species to survive. describe how changes in the environment can bring about changes in species through natural selection, adaptation, and extinction. comprehend that individuals of a population exhibit a range of variations in a trait as a result of the variations in their genetic codes. explain that if a species does not include traits that enable it to survive in its environment, or to survive changes in the environment, then the species may become extinct. comprehend that mutations are inheritable changes because a mutation is a change in the DNA code.	LS.14	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	Galapagos Education: http://pubs.nsta.org/galapagos/resources/page1.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating Organic Evolution (continued)	comprehend that a mutation may result in a favorable change or adaptation in genetic information that improves a species' ability to exist in its environment or a mutation may result in an unfavorable change that does not improve or impedes a species' ability to exist in its environment. analyze and evaluate data from investigations on variations within a local population. interpret data from simulations that demonstrate selection for a trait belonging to species in various environments. describe and explain how fossils are records of organisms and events in the Earth's history. explain the evidence for evolution from a variety of sources of scientific data (including the fossil record, radiometric dating, genetic information, the distribution of organisms, and anatomical and developmental similarities across species).	LS.14		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating the Conservation of Living Resources	**Students should be able to:** identify examples of ecosystem dynamics. describe the relationship between human food harvest and the ecosystem. describe ways that human interaction has altered habitats positively and negatively. explain that human input can disturb the balance of populations that occur in a stable ecosystem. These disturbances may lead to a decrease or increase in a population. As populations in an ecosystem are interdependent, these disturbances have a ripple effect throughout the ecosystem. debate the pros and cons of human land use versus ecosystem stability. compare and contrast population disturbances that threaten and those that enhance species survival. observe the effect of human interaction in local ecosystems and collect, record, chart, and interpret data concerning the effect of interaction (from observations and print and electronic resources).	LS.12	Student demonstrations Classroom observations Student laboratory reports Quizzes Tests	*Project WILD activity guide:* http://www.dgif.state.va.us/education/wildlife_education.html *Project Wild Aquatic* activity guide: http://www.projectwild.org/materials/materials.htm *Project WET* activity guide: http://www.deq.state.va.us/education/wetinfo.html *Virginia Naturally: VA's Natural Resources Education Guide:* http://www.vanaturally.com/guide.html

Organizing Topic	Essential Knowledge, Skills, and Processes	Related SOL	Sample Classroom Assessment Methods	Sample Resources
Investigating the Conservation of Living Resources (continued)	design an investigation from a testable question related to the relationships between ecosystem dynamics and human activity. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. analyze and critique the experimental design of basic investigations related to the relationships between ecosystem dynamics and human activity.	LS.12		
	apply the LS.1 science skills in the context of the content of this topic.	LS.1		